COLORED STONES

ASSIGNMENT 13

PEARL

IDENTIFICATION, PRODUCTION, MARKETING, BUYING

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I. INTRODUCTION

Pearls have been cherished since the earliest times of mankind, when the search for food along seashores and rivers undoubtedly led primitive man to their discovery; today, they are still among man's most prized possessions. Perhaps part of the reason that they have been so widely used is that they require no fashioning to reveal their beauty. No other object used for personal adornment has held its comparative position of desirability for so long. The pearl is classed as an organic gem material. It shares honors with moonstone and alexandrite as the birthstone for the month of June.

A. PEARLS THROUGH THE AGES

Pearls are mentioned in the book of Job and in the Talmud. Later, the Egyptians, Persians, and Hindus held pearls in great esteem, and through them the Romans became acquainted with them. The pearl was the favorite gem among the rich in the Roman Empire; men and women competed in the lavish use of pearls as articles of adornment. Couches and trappings shone with the splendor of pearls, and Roman women even wore them in their sleep, to remind them of their wealth when they awoke.

Pearls brought back from the Orient by the Crusaders probably spread appreciation of these gems in Europe. In later centuries they were used so lavishly as personal ornaments by lords, ladies, and knights that one period was even referred to as the "Pearl Age."

Queen Elizabeth I and Catherine de Medici were great pearl lovers, as shown by their portraits, and other royalty of the day shared this love, since by then the pearl had already been long known and cherished as a royal gem. Rulers vied with one another in the extravagant use of pearls, some even enacting legislation restricting their use among their subjects. In 1530, the officials of Augsburg permitted the wives of nobles to have four silk dresses, but banned the use of pearls. In 1612 a law of the Duke of Saxony read: "The nobility are not allowed to wear any dresses of gold or silver or those garnished with pearls; neither shall the professors and doctors of the universities nor their wives wear any gold, silver or pearls for fringes, or any chains of pearls, or caps, neck ornaments, shoes, slippers, shawls, pins, etc., embellished with gold or silver or pearls."

Recent discoveries of large quantities of freshwater pearls in ancient burial mounds in Ohio confirm reports by early travelers that the American Indians from that area used pearls ornamentally. The mound builders set pearls in necklaces, headdresses, and ornamental copper objects, and used them as artificial eyes in figures of animals cut from copper and pipestone. They prized these fresh water pearls so highly that they even made imitations out of mica covered clay.

Pearls possessed by the Indians attracted explorers seeking Eldorado in the early expeditions that followed Columbus's discovery of America. Tales of vast pearl treasures lured the Spanish adventurers to America. One early writer described a trip inland when he saw these gems "in every hut, ranging in quantity from a pint to a peck." De Soto's men described visits to Indian temples that were festooned with them. One writer enthused: "There was such a wealth of pearls in one temple that nine hundred men and three hundred horses could not have moved them at one time!"

Such accounts were undoubtedly exaggerated, but the explorers probably saw many pearls in the possession of the natives. When the natives generously showed the newcomers how they fished for pearls, they were later rewarded by being pressed into service to fish for them by some of the more heartless adventurers.

B. FAMOUS PEARLS

Only a few pearls have become famous for both unusual size and beauty, principally because maximum beauty is seldom found in the largest pearls, and the size of any regular-shaped whole pearl is limited by the size of the mollusk in which it grew. (This is not true of very irregular masses or those that are attached to the shell, which may constitute most of one side of the shell.) In contrast to many famous diamonds, most pearls mentioned in antiquity lost their identity or were destroyed. Those still intact are the prized possessions of museums or private collections.

One of the largest saltwater pearls still in existence is the Hope Pearl, first acquired early in the 19th century by a London banker, Henry Philip Hope, and now displayed in the British Museum of Natural History. This remarkable specimen, weighs 1,800 grains, but it is not spherical; it is 2 inches long, 4½ inches in circumference at the broadest part, and 3¼ inches in circumference at the narrowest. Perhaps the finest freshwater pearl known is the Queen Pearl; it is round and translucent and weighs 93 grains. Found near Paterson, New Jersey in 1857, it was later sold to the Empress Eugenie. La Pellegrina, renowned as one of the world's loveliest oriental pearls, is round and weighs 111½ grains. It is now in the Museum of Zozima in Moscow. The 1,191-grain teardrop-shaped pearl called "The Miracle of the Sea" is currently owned by the Imperial Pearl Syndicate. (It was formerly in the crown jewels of the Emperor of China.)

No royal treasury is without quantities of pearls to be used in necklaces and other forms of jewelry. The treasury of the Gaekwar of Baroda, for example, contains a sash made of 100 rows of pearls, 7 strands of pearls valued at nearly one million dollars, a litter set with thousands of seed pearls, and a carpet of pearls 10½ feet long and 6 feet wide. This carpet, with an estimated value in excess of a million dollars, may well be one of the most costly ornaments of its kind in the world. Pearls appear by the thousands in the crown jewels of Iran, notably in the Pahlavi and Kiami crowns, the latter containing about 1,800 pearls, each from 10 to 20 grains in weight.

C. DERIVATION OF NAMES

The English word pearl (as well as comparable words in German, French, Italiàn, Spanish, and other modern languages) comes from the Latin word *pernula*. Latin names such as *Unio* and *Pina* were chosen by zoologists as names for some of the important genera of pearl-producing mollusks. Some of the words associated with pearls can be traced through a number of languages. For example, another Latin name for pearl, *margarita*, came from the Greek *margarites*, which may have derived either from the Babylonian for "child of the sea" (which came from a Sanskrit word through Persian) or from one of the other Eastern languages (most of which had words of the same root). This is the source of the names Margaret, Marguerite, and Margarita.

II. THE NATURE OF PEARL-BEARING MOLLUSKS

Gem pearls have been found in a variety of mollusks. The most important genus, which contains the major pearl-bearing species, has been known by various names including *Meleagrina, Margaritifera, Pteria* and *Pinctada*; current usage favors the name Pinctada. Saltwater pearls are produced by four major species of this genus, listed in order of decreasing shell size: *Pinctada maxima, Pinctada margaritifera, Pinctada vulgaris,* and *Pinctada martensii.* The last is the small oyster cultivated in great numbers in southern Japan for the production of cultured pearls. Before the advent of spherical cultured pearls, however, Pinctada martensii had been a major source of natural pearls. The major saltwater pearl-producing areas have one or more varieties of vulgaris or margaritifera, the most important species.

The body of the Pinctada mollusk is enclosed within two hinged shells, or valves, of about equal size. Usually, the lower shell becomes attached to some object and only the upper one opens and closes. It is controlled by a pair of strong muscles, the adductors. The main portion of the body is separated from the shells by the **mantle,** a protective, tent-like membrane that is more or less folded within the shell to form two flaps. Figure 1 shows the vertical cross section of the mollusk; figure 2, the horizontal.

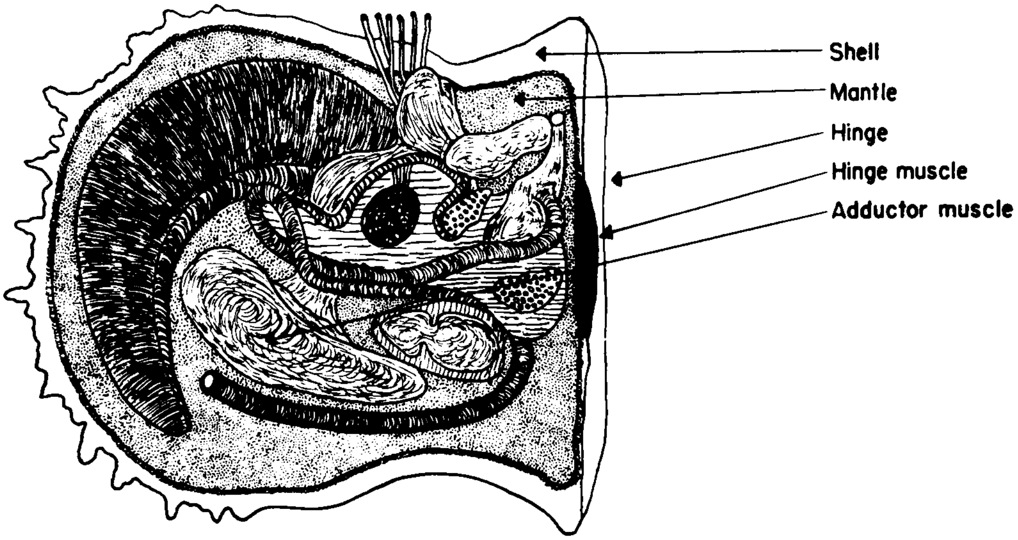


Figure 1

The outer layer of the mantle, which is in contact with the valves, is known as the epithel*ium* (pr*ou*nounced ep-uh-THEE-lee-um); it contains cells that secrete the several different materials to produce the shell and nacre. These epithelial cells secrete calcium carbonate in three forms: coarse calcite prisms, coarse aragonite (pronounced ah-RAG-oh-nite) prisms, and tiny, irregular plates (platelets) made up of a multitude of minute, short, stubby, aragonite prisms. They also secrete **conchiolin** (pronounced kon-KI-oh-lin), an organic substance similar to fingernails. This substance acts as a cement to bind the carbonate prisms together; it also forms a protective coating for the exterior of the shell. Only those cells at the outer edge of the mantle produce the tough conchiolin exterior and coarse prismatic crystals that form the permanent outer structure of the shell (once formed, this part of the shell never changes). In the meantime, the remaining mantle cells deposit iridescent layers of a substance called **mother-of-pearl** — when they occur on the inner walls of the shells or **nacre** (pronounced NAY-ker) — when they occur on pearls.

As seen in cross section, the shell consists of a horny outer layer of conchiolin (see a of figure 2), known as the periostracum (pronounced pear-ee-AHS-trah-cum), a somewhat thicker section of prismatic calcite or aragonite (see b of figure 2), and finally an even thicker inner section made up of numerous mother-of-pearl layers (see c of figure 2). The second and third sections (inside the tough conchiolin exterior) actually consist of many layers of crystals separated by layers of conchiolin. A fourth layer of prismatic crystals called the hypostracum (pronounced hy-POS-trah-cum) is confined to the area of the interior near the hinge (see d of figure 2).

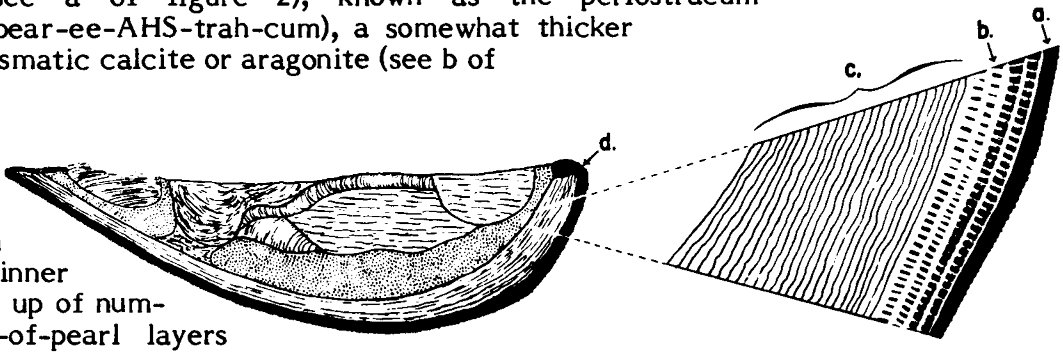


Figure 2

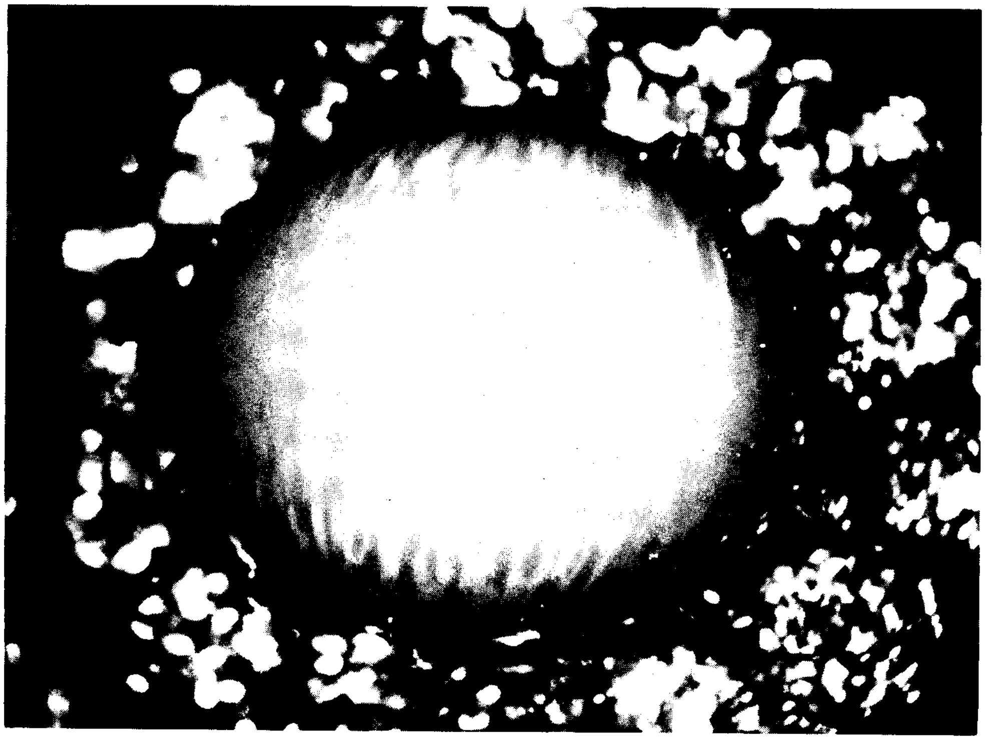


Figure 3 STRUCTURE OF A CONCH PEARL AS SEEN IN REFLECTED LIGHT

The pearl-bearing oysters are not those regarded as edible in the Western world; in fact, gem pearls have never been found in our edible oysters. In contrast to the oysters that are the chief supply of saltwater pearls, the major source of freshwater pearls is the mussel, or clam, of the genus *Unio*. Various species of Unio, a number of which produce attractive pearls, are found in rivers in many parts of the world. Pearl-like objects are found in many mollusks and other invertebrates, but very few have the **orient** (or iridescence) shown by the nacre found on true pearls. Instead they are known as calcareous concretions.

Calcareous concretions in edible saltwater clams, such as the cherrystone clam, are also lusterless and without value as gems. Abalones can produce pearls with some orient; these usually are vividly colored, but most of them are misshapen. Conch (pronounced konk) mollusks also produce concretions which are sometimes set in jewelry. They cannot be classed as pearls, however, because they lack nacre. Many people like the pink colors of the conch, but are less attracted to white or yellowish porcelain-like concretions of the Tridacna. The Tridacna is the giant clam so often portrayed in old movies as the menace to the south seas pearl diver, should he put his foot or hand in it and become trapped.

III. THE CAUSE OF PEARL FORMATION

Our forebears had some fascinating theories about the formation of pearls. For example, early history recorded the belief that a drop of dew falling into the sea was caught by an open mollusk and formed into a pearl. In good weather, a lovely pearl was formed; in poor weather, a dark, less attractive pearl resulted. Later, as science began to develop, more accurate theories evolved. In 1554, for example, an investigator named Rowdelet maintained that a pearl was a gallstone. A half century later, Anselmus de Boot, noting the resemblance between the interior of the shell and the surface of the pearl, reasoned that the shell held fluid generated by the shellfish and retained it to form a pearl. In 1671, a scientist named Redi expressed the belief that when a grain of sand worked its way into the shell, a pearl formed. Shortly thereafter, another researcher declared that undischarged eggs of the mollusk were responsible.

In the 19th century, a number of investigators cut pearls in half in order to study their interiors and found parasites, parasite eggs, and a variety of other objects, both organic and inorganic. In 1904, Boutane, a French scientist, came to the conclusion that if a parasite worked its way inside a shell and into the mantle, part of the mantle would separate and become a pearl. Boutane was close to the truth. Subsequent research into the role of epithelium cells in the growth of the shell, coupled with comparisons between pearls and the shell's mother-of-pearl layers, clarified the process of pearl growth. **It was determined that if an irritant lodges between the shell and the mantle, it causes an indentation, accompanied by increased epithelial cell development.**

As shown in figure 4, the usual reaction is that the epithelium cells surround the irritant and begin to deposit nacre around it. If the irritant is enclosed early in the life of the mollusk, a complete pearl can develop, its size determined by the size of the mollusk, the temperature of the water in which the animal lives, and the length of growing time. In the relatively cool Japanese waters, nacre accretion increases the radius at an average rate of about 0.15 mm annually in the small Pinctada martensii.

In the warmer waters near the Equator, accretion may proceed at least 20 times faster.

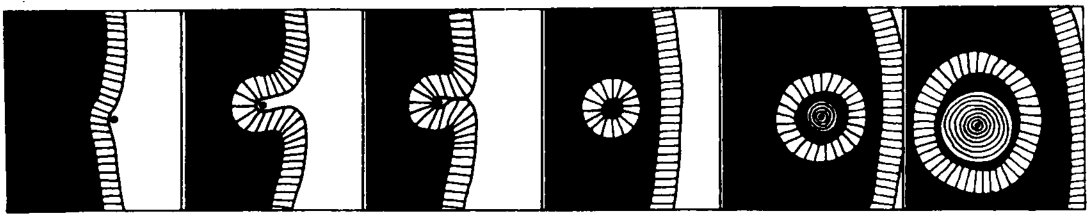


Figure 4

Figure 5 shows what happens if the irritant becomes attached to the shell rather than to the mantle: it causes the formation of a **blister pearl.** The gradual deposition of nacre on the shell surrounding the irritant forms a protrusion on the shell's surface that occasionally becomes nearly hemispherical.

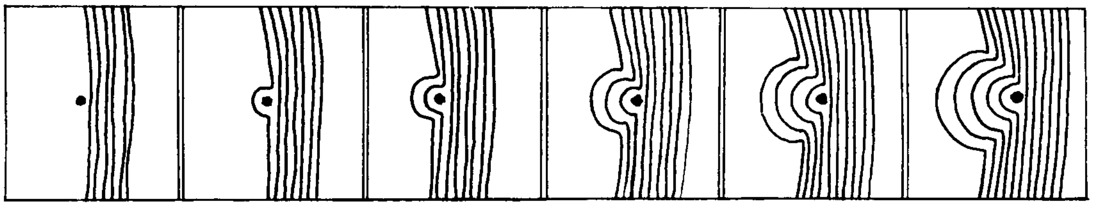


Figure 5

IV. STRUCTURAL CHARACTERISTICS OF PEARLS

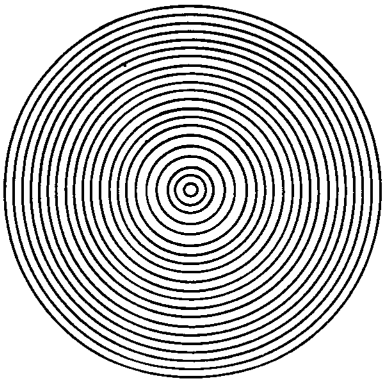


Figure 6

To form a round pearl, the mollusk deposits layers of material concentrically about the nucleus, as seen in figure 6 (an actual pearl has many more layers). These layers may correspond with any or all of the shell layers; they may consist almost entirely of nacre, of calcite or aragonite prisms, or of a combination. **However, unless at least the outer layers consist of nacre, the concretion is not considered a pearl.** Figure 7 is a magnified surface view of the irregular positioning of the overlapping crystals or platelets comprising the nacre. This positioning gives rise to the diffraction and interference of light that produces iridescence (called **orient** when seen on the surface of a pearl).

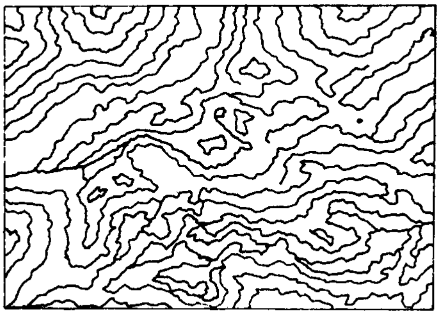


Figure 7

Figure 8 illustrates a cross section of a nacreous layer. Differences in the numbers and thickness of these layers are responsible for the different qualities of orient and translucency of pearls. As a general rule, the greater the number of nacreous layers below the surface, the better the pearl.

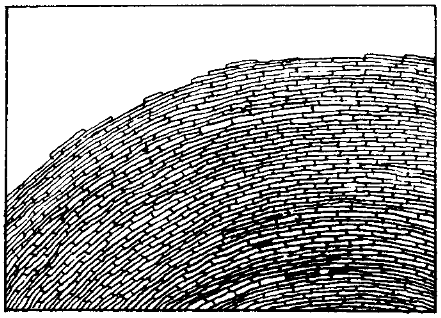
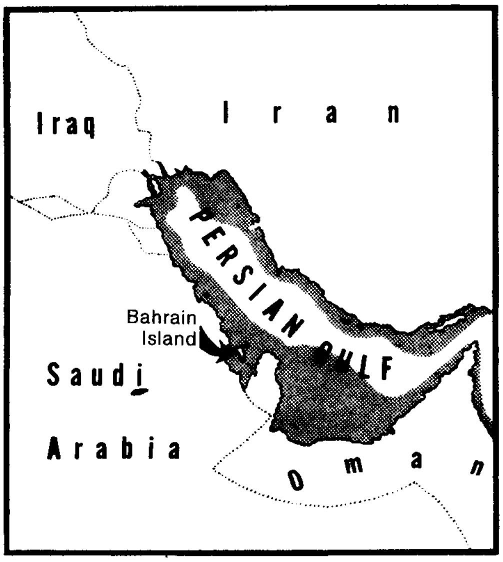


Figure 8

The only difference in nonpearl-producing mollusks (such as edible oysters) is that the epithelial cells are not capable of producing the semitransparent, flattened aragonite crystals (platelets) necessary for the formation of mother-of-pearl or nacre. They can only produce the coarse calcite and aragonite prisms and conchiolin.

V. SOURCES, RECOVERY METHODS, AND DISTRIBUTION



The major source (at one time, almost the only important source) for the most valuable type of pearl — that produced naturally by saltwater mollusks — was the Persian Gulf. Here the Pinctada vulgaris and Pinctada margaritifera were the pearl-producing mollusks, as they are for most saltwater pearls; the vulgaris is the largest pearl producer. The fishing grounds were located in fairly shallow waters along most of the shoreline, particularly along the western side of the Gulf to the north and south of Bahrain Island, but also in the southern and northern part of the Gulf. The mollusk banks were at a depth of four to eight fathoms (one fathom equals 1.83 m or six feet). Large areas of the Gulf are shallow, and some banks were located 96 km (approximately 60 miles) or more from the shore.

There were hundreds of small fishing boats, each manned by about ten seamen and one or a few divers. Each diver carried a collecting bag for the oysters he dislodged from the bottom, and trailed a rope or cable to the surface for signaling his need to be pulled up. In deep water, weights and a nose clamp were used. Some divers could stay down as long as four minutes at a time, but one to two minutes was more common. If the owner of the boat was aboard or if it was owned by the crew, the oysters were opened on deck; otherwise, the catch was taken ashore to be opened. The pearl yield was very low for the number of mollusks gathered. Although there was wide variation from bed to bed, even in the formerly important Persian Gulf fisheries, only about one mollusk in forty contained a pearl.

After recovery, Arab dealers purchased the pearls, took them to Bombay, and sold them to Indian merchants. Up to this point, nothing had been done to the pearls beyond simple washing. (Pearls are frequently much less attractive at this stage than they are when we see them, because organic materials may still cling to them and also slightly discolor them.) In Bombay the pearls were bleached by immersing them in hydrogen peroxide and leaving them in the sunlight for hours. Following this they were sorted, graded, and drilled. The poorest qualities were immediately separated for use in oriental countries. Approximately 90% of the medium and fine qualities found their way to the pearl markets of Paris; of these, a significant proportion reached the United States.

Paris was a major purchasing and distribution center for natural saltwater pearls, although many that were destined for the U.S. market were shipped there directly from Bombay. Pearls of all qualities from the Persian Gulf arrived in the United States via three main channels: (1) sent directly from Bombay; (2) purchased by agents in Bombay; or (3) via consignment houses or brokerage firms in Paris or London. The brokers exhibited them to dealers, who inspected the merchandise and made offers that were then transmitted to the Bombay owners. Bombay remains, as in the past, mainly a brokerage or commission center.

Minor pearl-producing regions today include the Gulf of Manaar between Sri Lanka and India; the north, northwest and northeast coasts of Australia; Japan; the Gulf of Mexico; Panama; Venezuela; and the South Sea Islands, including Tahiti. (Venezuelan pearls are fished off the coast of Margarita Island, whose name is the Roman word for pearl.) Natural freshwater pearls can be found in almost any fairly large river in a temperate climate. They have been found in the United States (principally in tributaries of the Mississippi river), in Scotland, and in China. Florida and the West Indies are sources of "conch pearls."

VI. THE COLOR VARIETIES OF PEARLS

The color of most pearls is the result of two separate components: **body** (or background) **color** and **overtone.** When present, the overtone will be superimposed on the body color. The body color is most easily distinguished visually from the overtone under soft, diffused light. The overtone is seen in the actual reflection of the light source from the surface of the pearl, and the remainder of the pearl shows the body color. Overtone colors include rosé (a rose color, but pronounced ro-ZAY), blue, and green (in order of decreasing desirability).

Pearls can be classified on the basis of **body** color into three major groups: **light, black,** and **colored.**

A. LIGHT

In this group are pearls with pink, white, or cream body colors. They are further divided as follows:

1. Pink

Pink body color with no overtone.

2. Pink Rosé

Pink body color with a rosé colored overtone often accompanied by blue or green overtones.

3. White

White (or very nearly white) body color with no pronounced overtone; instead, a faint cast or tint of pink, gray, or blue.

4. White Rosé

White or nearly white body color with a rosé colored overtone.

5. Cream

Light, medium, or dark cream body color with no overtone. The term light cream is used for very light yellow of low intensity (yellow-brown); dark cream is used for medium yellow-brown.

6. Cream Rosé

Cream body color with a rosé colored overtone. The cream body color may be light, medium, or dark; the variations are light cream rosé, medium cream rosé and dark cream rosé. Cream rosé pearls are much more valuable than cream pearls without a rosé overtone.

7. Fancy Pearls

These always have three colors. The body color is cream, varying from light to very dark. An overtone superimposed on this is the second color, rosé. The third color is another overtone, which may be blue or green. (A blue overtone will combine with the rosé to produce a purplish cast.)

Of the light group of pearls, the most valuable colors are pink, pink rosé, and white rosé.

B. BLACK

This group includes truly black pearls and *dark* gray specimens as well. Also grouped under black are *dark* blue, purple, blue-green, green, and bronze pearls with a pronounced metallic overtone. The most valuable are those with a black body color and a metallic green overtone. An intense, even color is essential in any black pearl; dingy (low intensity) colors are much less valuable.

C. COLORED PEARLS

Colored pearls are those that cannot be placed in either the light or the black group. They exhibit a pronounced hue as a body color, usually a light to medium tone of yellow, green, blue, violet, purple, or gray. These colors are more common in freshwater pearls than in saltwater pearls.

Another type, in which the same body color does not extend uniformly over the surface, is called a two-color pearl. For a necklace, a round two-color pearl is less desirable than one having a more uniform overall color, even if one portion is very attractively colored. Two-color pearls can be used to advantage in rings or other jewelry pieces, either for an unusual effect or positioned so that only the more attractive side shows.

Another component of pearl color, by far the most rare, is a very high degree of orient, the iridescent sheen which moves on the surface of the pearl. It is caused by interference and diffraction of light among the tiny crystals in the layers of nacre. In order for a pearl to have a very high degree of orient, it must have a thick coating composed of many layers of these exceedingly thin, transparent nacre platelets.

Comparative Popularity of Pearl·Colors in Various Localities

	UNITED STATES	CANADA	NORWAY	ITALY	FRANCE	SWEDEN	West GERMANY	DENMARK	ENGLAND	MEXICO	FINLAND	SWITZERLAND	BELGIUM	BRAZIL	AUSTRALIA	SINGAPORE	HONG KONG
White	○				●				●	●		●					
White Rosé	○	◯	○	○	○	○	◯	○		○	○	○	○		○	○	◯
Pink Rosé	◯			○			○									◯	
Light Cream Rosé				◯													
Cream Rosé			◯		◯	◯	◯	◯	◯	◯	◯	◯			◯	●	
Light Cream													○				
Cream													○	○		●	
Yellow			●	●	●	●	●	●	●	●	●	●		○		●	
Gold														◯			

◯ Very Popular
○ Popular
● Disliked

VII. TRADE NAMES

Although a wide quality range is found in all pearl fishing areas, the majority of pearls from any given area possess characteristics, principally of color, that are peculiar to that area. For this reason, it was once a common practice for dealers to use locality names for pearls with characteristics common to that locality, even though they may have originated elsewhere. This procedure has its limitations, but is still used by the small number of natural pearl dealers. The following is a list of locality names for pearls that have been used in the trade, together with the characteristics associated with each name:

A. ORIENTAL PEARLS

A few American pearl dealers have used this term to describe only natural pearls fished from the Persian Gulf or off Sri Lanka. However, it has been the more general trade custom to call all natural saltwater pearls oriental, including all the kinds mentioned below as well as pearls fished from minor sources. Because of the confusion among laymen and members of the trade resulting from this broad use of the term, the Federal Trade Commission has declared it an unfair trade practice to use the term "Oriental" to describe cultured or imitation pearls, natural pearls not found in saltwater mollusks of the Persian Gulf, or natural pearls lacking the distinctive appearance of, or being the type of pearls coming from such mollusks. Note: Persian Gulf pearls usually have a white to cream body color (rarely, greenish white) with good orient and overtones of various colors.

B. CEYLON OR MADRAS PEARLS

These have fancy overtones of green, blue, or purple on a white or light cream body color.

C. TAHITI OR ISLAND PEARLS (often simply called South Seas)

These are white with only a slight overtone. Yellow, gray, and black pearls of a distinctive appearance are also found off Tahiti and other South Sea islands. A slightly grayish, metallic cast is also characteristic of pearls from this source.

D. VENEZUELA PEARLS

These are usually yellow or may be very white and more transparent than pearls from oriental sources. A greenish overtone is common. Since most are used locally, very few reach the world market at present.

E. AUSTRALIAN PEARLS

These are very white with little or no overtone. Those with more luster are described as "silvery." Pearls from other sources with a similar appearance are often called Australian pearls.

F. LA PAZ PEARLS

These are usually black, gray, or yellow. Occasionally, however, pearls are found that are comparable in appearance to Persian Gulf pearls.

G. PANAMA PEARLS

These may be any color, even similar in appearance to Persian Gulf pearls.

H. FRESHWATER OR AMERICAN PEARLS

These usually have strong colors and may have high luster and orient. Fancy colors and dead white pearls are common.

I. OTHER TRADE NAMES

The terms "blue pearl" and "mud pearl" are applied to those with a center of "mud," or more likely coarsely crystalline calcite or aragonite. "Maiden pearl" is a fanciful term applied to newly fished pearls. "French pearl" is a misnomer, since it is merely an irregular piece of shell, usually cut from the portion of the valve near the hinge.

VIII. SHAPES AND TYPES OF PEARLS

A. ROUND

As spherical as possible. (This is the most desirable shape for a pearl.)

B. PEAR

Smooth, with one end smaller than the other.

C. EGG

Smoothly oval.

D. DROP

A smoothly shaped tear-drop.

E. BUTTON

More or less rounded (spherical) on one side, somewhat flattened on the other.

F. BAROQUE

All asymmetrical or irregular shapes (i.e., any except round, pear, egg, drop, or button).

G. SLUG

A baroque pearl with poor luster.

H. HALF-PEARL

The trade term for pearls cut to produce a hemispherical or domed shape with a flat side; actually one-half of a round pearl.

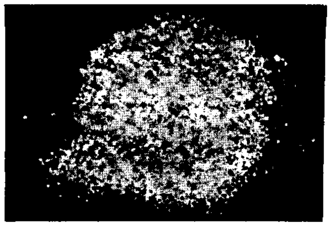
I. THREE-QUARTER PEARL

Three-fourths of a round pearl with a flat cut side.

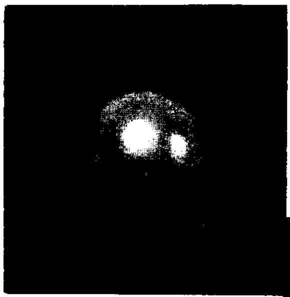
J. SEED PEARLS

This term normally refers to all pearls 2 mm or less in size, or less than 1/4 of a grain in weight. They are usually asymmetrical.

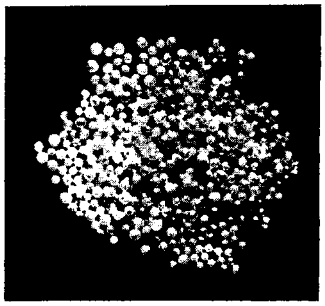
PEARL SHAPES



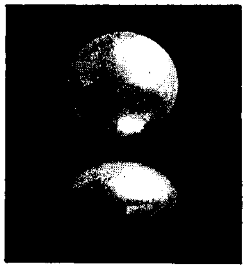
DUST Pearls



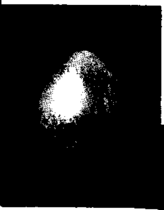
ROUND



SEED Pearls



BUTTON



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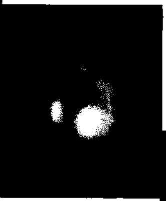

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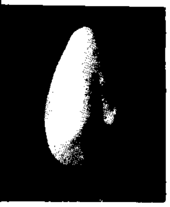

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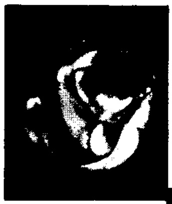
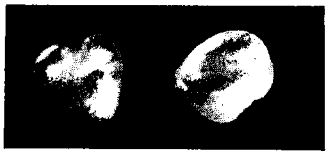
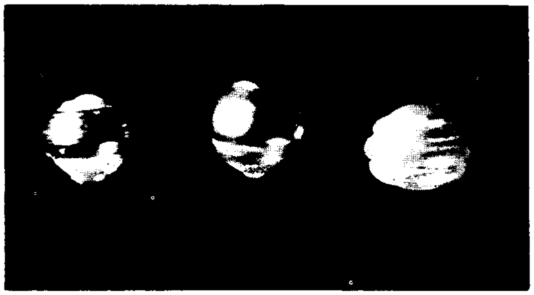


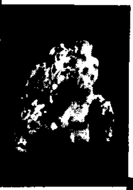
NUGGET
Baroque



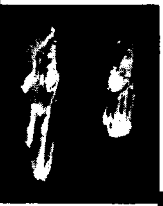
LEAF
Baroques



"ROUND-A-CIRCLE"
Baroques

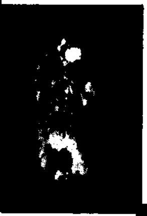


MONSTER
Baroque

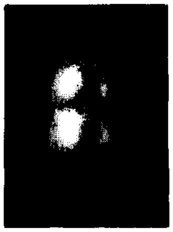


DOG TOOTH
Baroques

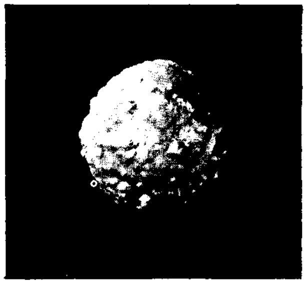
BARREL
Baroque



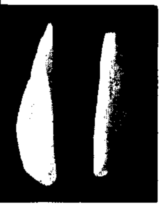
FEATHER
Baroque



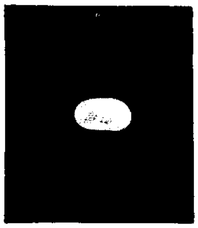
TWIN
Baroque



STRAWBERRY
Baroque



WING
Baroques



HAMMER
Baroque

K. DUST PEARLS

Asymmetrical pearls weighing less than 1/25 of a grain; they are too small to be useful for jewelry.

L. BLISTER PEARLS

These are found attached to the shell; therefore, they are not classed as true pearls. They are usually irregular or flattened and may be hollow, sometimes containing clay, water, or even a true pearl (which was not originally attached to the shell). They can occur in most pearl-bearing mollusks.

IX. PHYSICAL AND OPTICAL CHARACTERISTICS

PHYSICAL

Chemical Composition (approximate)	$CaCO_3$(aragonite and/or calcite)	91.6%
	H_2O	4.0%
	Organic matter	4.0%
	Loss in analysis	0.4%
		100.0%
Crystallographic Character	An aggregate composed largely of minute orthorhombic (pseudohexagonal) aragonite crystals and (sometimes) hexagonal calcite crystals. Conchiolin, the cementing material, is noncrystalline and organic.	
Cleavage	None	
Fracture	Uneven	
Hardness	2½ to 4	
Toughness	Usually good, but variable. Many pearls are quite tough, but **toughness is not constant and care must be exercised in handling them. The outer surface layers may be fractured or scratched very easily.** Toughness may also be affected by age, dehydration, or excessive bleaching when the pearl is processed for the market.	
Streak	White	
Specific Gravity	Oriental saltwater natural pearls: 2.66 - 2.76. Some Australian pearls are as high as 2.78. Gulf of Mexico pearls: 2.61 - 2.69. Freshwater natural pearls: about 2.66 - 2.78; few are over 2.74. Inferior	

pearls are often much lower. "Conch pearls": near 2.85.

OPTICAL

Degree of Transparency	Translucent to opaque.
Luster	Varies from dull to almost metallic, depending on the nature of the layers and their degree of transparency. Fracture surfaces are pearly to dull.
Phenomena	Orient. Varies from almost none to very pronounced.
Characteristic Inclusions	None
Pleochroism	None
Refractive Index	1.53 - 1.686. Because of the curved surfaces of pearls, approximate R.I. (and birefringence) can be detected only by the spot method.
Birefringence	0.156
Dispersion	None
Optic Character	Doubly refractive.
Ultraviolet Fluorescence	None to strong light blue, yellow, green, or pink under both short and long wavelengths. Natural color black natural pearls fluoresce from light pink to bright or dark red under long-wave.
Color-Filter Reaction	None
Absorption Spectra	Varies widely; no diagnostic value.

(Note: Although X-ray equipment is not readily available to gemologists, the results of such testing are listed here for the sake of completeness.)

Transparency to X-Rays	Semitransparent
X-Ray Fluorescence	Saltwater natural pearls are inert, except for some very white pearls from Australian waters which

	fluoresce faintly. Most freshwater natural pearls fluoresce a moderate to strong yellowish white.
X-Radiography	More or less concentric structure. Normally, either the pearl photo is the same tone throughout, or the center may appear **darker**, not lighter.
Effects Caused by:	
Heat	Excessive heat, such as an open flame, may cause pearls to burn, turn brown, split, or crack. Prolonged moderate heat can cause dehydration, which can make the nacre crack.
Acids	Attacked violently by all acids. Acid perspiration or perfume will also attack nacre.
Irradiation	Darkens color.

X. IDENTIFICATION

The difficult matter of making a positive separation between natural and cultured pearls, which usually requires the use of X-ray equipment, is discussed in detail in the next assignment. The identification of imitation pearls is discussed in detail in the assignment on imitations, but there is one easy test: imitations usually feel smooth to the biting edge of the front teeth, while both natural and cultured pearls feel "gritty."

XI. CARE OF PEARLS

Pearls are more vulnerable than many other gems. Heat, perfume, excessive perspiration, face powder, hair sprays, skin oils, or constant contact with hard or rough-textured fabrics may damage the delicate outer surface of pearls. Contact with other jewelry during normal wear can leave them scratched and worn. Pearls should be strung with knots between them; otherwise, the friction caused by direct contact will cause wear at the drill holes. In addition, if the string breaks, the knots will also prevent the loss of more than one pearl. Care must be exercised in repairing pearl jewelry, because heat may split pearls or turn them brown and acids will attack them violently.

Although many pearls retain their full beauty for centuries, they are subject to a gradual loss of water from the organic conchiolin binding agent. The greater the amount of conchiolin in a pearl, the more rapidly it will show signs of deterioration through dehydration. It may, however, take generations for yellowing, surface cracking, or other signs to become evident. If properly cared for, natural pearls should last for many lifetimes. Constant contact with perfume or acid perspiration is much more damaging than simple aging.

Clean pearls by immersing them in a mild nondetergent soapy solution; **use nothing stronger.** Avoid getting the string on a necklace wet; it may stretch. It is best to clean pearls with the soapy solution before restringing. GIA does not recommend cleaning pearl jewelry in ultrasonic cleaners. The lightly acid solution used in these cleaners may attack the nacre and the vibrations may cause further damage to pearls with internal or external cracks.

XII. EVALUATION

The inherent factors that affect the value of natural pearls are as follows:

A. COLOR

A pure, even color is essential in a pearl of fine quality; muddy, dull, or dingy colors are much less valuable. As described previously, the color of a fine pearl includes body color, overtone(s), and orient.

B. LUSTER

A very high luster of even intensity is also essential in a pearl of fine quality. Such pearls usually have many very thin, transparent nacreous layers.

C. DEGREE OF TRANSLUCENCY

The most valuable pearls are semitranslucent. Pearls lacking translucency will appear darker or denser than others of the same color in a necklace, especially in artificial light.

D. TEXTURE

A blemish-free natural pearl is rare; most pearls have one or more blemishes. Value is lowered by cracks, scratches, dents, bumps, an uneven surface, and white spots or other discolorations. A broken surface or graduations caused by polishing away slight bumps, also lowers the value. The effect on value varies with the position of blemishes and the extent to which they affect beauty. Pearls with obvious surface cracks are almost worthless.

E. SHAPE

An ideal pearl would be perfectly spherical, as though turned out by machine, but such perfection in any natural object is rare. Because of uneven color, translucency, or luster, some nearly spherical pearls may appear off shape, which lowers their value somewhat. Button, pear, or drop shapes, if symmetrical and of fine quality, are frequently very valuable.

F. SIZE.

As explained below, the quality of a natural pearl determines the base rate; this is then multiplied by the square of the weight. Therefore, any increase in size has a profound effect on price. Large pearls that meet all of the quality requirements listed above are exceedingly rare and all but priceless.

The remaining factors of pearl value are the result of matching and blending, artifical treatment, and drilling.

G. MATCHING AND BLENDING

The value of a necklace depends not only on the quality of the pearls but also on how they are matched and blended. Matching for color means grouping pearls of exactly the same color; blending means using very similar tones or tints of the same color whose similarity is apparent when the pearls are placed side by side. How well the pearls in a necklace are matched for size and shape, and how accurately they are matched for size in a graduated strand, also have a marked effect on the value of the necklace. The preparation of a well-matched (or well-blended) necklace requires time, care, and patience for the meticulous grading of many pearls. Such a strand is much more desirable and valuable than one that is poorly matched or blended.

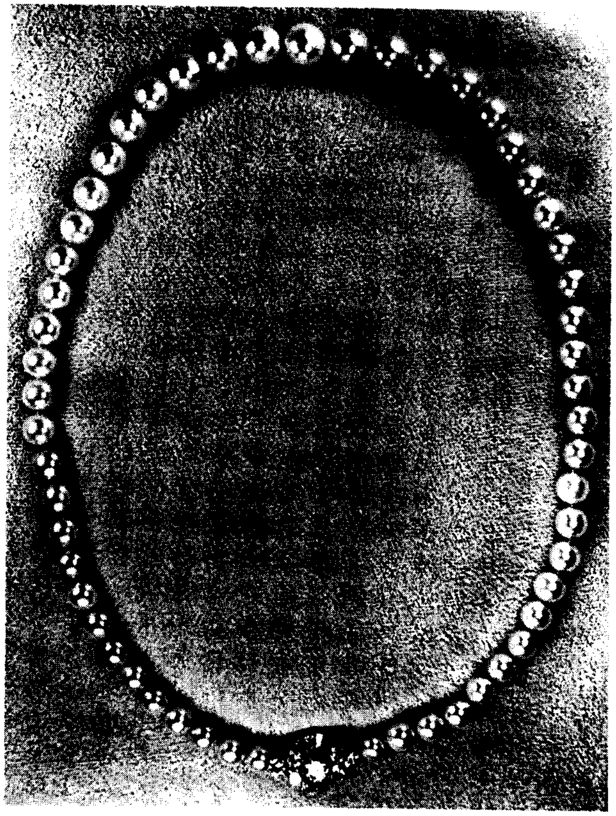


Figure 9 THE VALUE OF A PEARL NECKLACE DEPENDS ON THE QUALITY OF THE PEARLS AND HOW WELL THEY ARE MATCHED AND BLENDED.

H. ARTIFICIAL TREATMENT

The surface layers of a pearl may be filled with a colored solution; this is most often done to produce dyed black pearls. Slight surface or underskin cracks can often be temporarily "healed." Broken outer skins can sometimes be repaired, but only by the most skillful experts. Remember that the nacreous portion of a pearl does not consist of solid concentric layers but of minute, overlapping, plate-like crystals, similar to the shingles on a roof. "Peeling" a pearl (grinding or scraping away undesirable areas) is very risky and rarely done, because the underlayers may be dull, spotted, and worthless. Dents in the surface have been known to continue and even multiply as the work progresses. Off-shape pearls can be made round by removing uneven portions, but this seldom increases value.

I. DRILLING

Large or unevenly drilled holes can materially reduce value. A drill hole just large enough to accommodate a suitable silk thread is best. Pearls with very large drill holes, caused by either long wear or improper original drilling, are often plugged with a piece of hardwood, metal, mother-of-pearl, wax, or paste and redrilled with smaller holes (see figure 10).

XIII. METHODS OF CALCULATING VALUE

Most retailers handle too few strands of natural pearls to justify obtaining the lengthy training and experience that is necessary to evaluate them accurately. Pearl

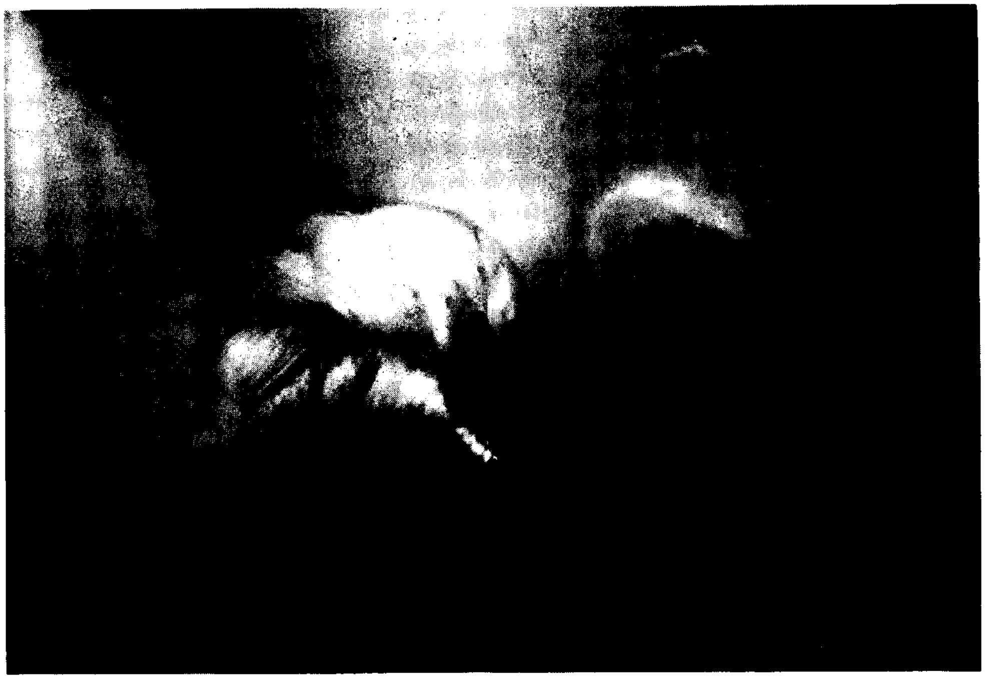


Figure 10 DRILL HOLE THAT HAS BEEN PLUGGED

evaluation is even more complicated than diamond evaluation; for example, the rarity of pearls rises more rapidly with increasing size than that of diamonds. In addition, a matched pair of pearls is worth much more in the pearl trade than the sum of the separate values of the two pearls before matching. To take such complicated relationships into account, pearl importers use a system based on what they call the "once" of a pearl or group of pearls, which incorporates size and a **base rate** covering the quality of the pearls and matching, if any. This system is rarely used by the retailer; we will illustrate it briefly with a few examples.

The quality of a single pearl determines the base rate; this is computed by the dealer on the basis of long familiarity with the pearl market. For example, he knows that in a given year a five-grain pearl that is round, free of all blemishes, lustrous, correctly drilled, and of the popular cream rosé color is worth a certain base, while smaller pearls of similar quality are worth so much less and larger ones so much more. The greatest need for experience is in learning how much to discount the base rate for variations from the quality levels just described; for example, how much to discount it if the pearl is not exactly round, slightly dimpled, too white or too brown, or some combination of these variations. This requires a lifetime of experience; hence, it is not surprising that there are so few pearl experts.

After the base rate is determined, the price of a single natural pearl is computed by squaring its weight in grains and multiplying the result by the base rate. For example, if a pearl weighs 8.65 grains and the base rate is $6, then 8.65 x 8.65 x $6 = $448.93. As another example, consider two matched pearls of nearly equal size that weigh a total of 17.30 grains. Because of excellent quality and matching, the base rate is advanced to $10. (When a pair of matched pearls is priced, the base rate is increased to compensate for rarity; in this case, it would actually have been doubled had the pearls been perfectly matched.) Their value is then computed as follows: 17.30 (total weight) x 8.65 (their average weight, or 17.30 ÷ 2) x $10 = $1496.45 for the two pearls. (To figure the value of two pearls of unequal size, the pearl dealer multiplies their *average* weight by the total of the two weights before multiplying by the base rate to obtain the "once" figure.)

To compute the price of a necklace, pearls of equal or nearly equal size at an equal distance on each side of the center pearl are grouped and priced as groups by this same method, until all pearls are accounted for, and then the price of all the groups is totaled to give the value of the necklace. Since the base rate itself is an estimate, however, an experienced pearl dealer should also be able to estimate the value of a strand fairly accurately even without using the complicated system just described.

XIV. THE PEARL MARKET TODAY

Prior to the Great Depression there were many natural pearl dealers in America and Western Europe as well as elsewhere in the world. Since 1930, a combination of factors has come close to destroying the market for natural pearls. Paris was the center for the assembly of gem necklaces and the marketing of natural pearls to dealers worldwide. A combination of factors resulted in most of those firms being forced to close their doors. Their demise and the loss of supply from the Persian Gulf, caused the natural pearl market to shrink to a tiny industry compared to what it was at zenith. At its best, when the mollusks were healthiest and most numerous, pearl diving was a very hazardous and unrewarding business for the divers. Life expectancy was very low, even if the diver did not accidentally drown. Yields were very low and hardly worth the risk involved. When the oyster beds became depleted through over fishing in the late 20s and disease problems reduced the number of mollusks, the pearl fishing of the Persian Gulf all but ended. Today there are very few dealers who handle natural pearls and, in general, the prices are considerably lower than they were at the peak of the market in the late 20s. When one considers that two strands of pearls were traded in 1916 for the building occupied by Cartier on Fifth Avenue, each strand had to have been valued at more than half a million dollars when the exchange was effected. The two strands were sold in 1957 at auction at Parke Bernet and brought $157,000.

Although the natural pearl industry has declined, it has not disappeared entirely. It is still possible to obtain natural pearls for collectors and discerning customers. A few firms continue to specialize in fine natural pearls, and occasionally strands are offered at auction. Even though natural pearls are rare and expensive, they are appreciated by discriminating customers who want only the genuine article.

WEIGHT ESTIMATIONS OF ROUND NATURAL AND CULTURED PEARLS

Diameter in Millimeters	Pearl Grains	Diameter in Millimeters	Pearl Grains	Diameter in Millimeters	Pearl Grains
1.0	0.02	5.7	5.25	10.4	32
1.1	0.03	5.8	5.50	10.5	33
1.2	0.04	5.9	5.75	10.6	34
1.3	0.05	6.0	6	10.7	35
1.4	0.06	6.1	6.50	10.8	36
1.5	0.08	6.2	6.75	10.9	37
1.6	0.11	6.3	7	11.0	38
1.7	0.14	6.4	7.50	11.1	39
1.8	0.18	6.5	7.75	11.2	40
1.9	0.21	6.6	8	11.3	41
2.0	0.25	6.7	8.50	11.4	42
2.1	0.28	6.8	9	11.5	43
2.2	0.32	6.9	9.25	11.6	44
2.3	0.36	7.0	9.75	11.7	45
2.4	0.42	7.1	10	11.8	46
2.5	0.50	7.2	10.50	11.9	47
2.6	0.53	7.3	11	12.0	48
2.7	0.59	7.4	11.50	12.1	49
2.8	0.65	7.5	12	12.2	50
2.9	0.70	7.6	12.50	12.3	51
3.0	0.75	7.7	13	12.4	52
3.1	0.82	7.8	13.50	12.5	53
3.2	0.90	7.9	14	12.6	54
3.3	1	8.0	14.50	12.7	55
3.4	1.10	8.1	15	12.8	57
3.5	1.25	8.2	15.50	12.9	59
3.6	1.30	8.3	16	13.0	61
3.7	1.40	8.4	16.50	13.1	63
3.8	1.50	8.5	17	13.2	65
3.9	1.60	8.6	17.50	13.3	67
4.0	1.75	8.7	18	13.4	69
4.1	1.90	8.8	18.50	13.5	71
4.2	2	8.9	19	13.6	73
4.3	2.25	9.0	19.50	13.7	75
4.4	2.40	9.1	20	13.8	77
4.5	2.50	9.2	20.50	13.9	79
4.6	2.75	9.3	21	14.0	81
4.7	2.90	9.4	22	14.1	83
4.8	3	9.5	23	14.2	85
4.9	3.25	9.6	24	14.3	87
5.0	3.50	9.7	25	14.4	89
5.1	3.75	9.8	26	14.5	91
5.2	4	9.9	27	14.6	93
5.3	4.25	10.0	28	14.7	95
5.4	4.50	10.1	29	14.8	97
5.5	4.75	10.2	30	14.9	99
5.6	5	10.3	31	15.0	101

One carat equals 4 pearl grains.
One gram equals 20 pearl grains, or 5 ct.
One momme equals 75 pearl grains, or 18.75 ct (used only for cultured pearls).